PETROGRAPHY.

California Eruptive Rocks. — The "bed-rock" series of the Sierra Nevadas underlying the sands, gravels, and volcanic rocks in the vicinity of Nevada City and Grass Valley, Cal., consists of highly altered sedimentary rocks, crystalline schists, and igneous rocks, much resembling pre-Cambrian complexes elsewhere, but which here are known to be much younger than Cambrian.

Lindgren[1] describes the old igneous rocks as comprising granodiorite, a type of rock intermediate between granite and quartz, — mica-diorite, aplite, granite-porphyry, diorite-porphyrite, diorite, gabbro, serpentine, diabase, porphyrite, augite-syenite, and amphibolite. The limits of variation of the granodiorite are shown by the following figures :

SiO_2	Al_2O_3	Fe_2O_3	FeO	CaO	MgO	K_2O	Na_2O
59–68.5	14–17	1.5–2.25	1.5–4.5	3–6.5	1–2.5	1–3.5	2.5–4.5

Its predominant feldspar is a plagioclase, though orthoclase is present in small quantities, often intergrown with albite forming micro-perthite.

The gabbros are distinguished from the diorites by the character of their feldspathic component. This is a mediumly acid variety in the diorites and a basic variety in the gabbro. The ferromagnesian constituent in the latter rock may be either pyroxene, hornblende, or mica; though, as a matter of fact, all the gabbros described by the author contain some form of pyroxene or its alteration product. The serpentine is derived from pyroxenite and peridotite.

The diabases and porphyrites probably represent the cores of old volcanoes. These rocks grade into each other through so many different types that the author finds it difficult to classify them. The principal distinction made use of in defining them appears to be coarseness of grain, "since the diabase may readily become porphyritic, the resulting rock being referred to as diabase-porphyrite. A more pronounced porphyritic structure with finer-grained holocrystalline groundmass gradually leads over into the porphyrites, referred to as augite-porphyrites or hornblende-porphyrites." A majority of the porphyrites might be classed as apo-andesites, though the rocks are very different from the andesites of the district.

[1] *Seventeenth Annual Report of the U. S. Geol. Survey*, vol. ii, p. 2. Washington, 1896.

The amphibolites are "massive or schistose rocks composed chiefly of hornblende, usually with smaller quantities of quartz, feldspar, epidote, and chlorite." They are in most cases dynamically metamorphosed diabases or porphyrites.

The sedimentary rocks of the district are siliceous argillites, clay-slates, quartzites, and micaceous schists. These are altered by both dynamic and contact metamorphism.

The metamorphic processes, excluding weathering, are divided into: (1) dynamic metamorphism, including dynamo-chemical metamorphism, as in the case of the formation of amphibolites from diabases; (2) common hydro-metamorphism produced at low temperatures; (3) hydro-thermal metamorphism, including solfataric metamorphism, and (4) contact metamorphism. The most important characteristic of dynamo-chemically metamorphosed rocks is the production of mosaics. Feldspars are among the most important of the new minerals formed by this process. In hydro-metamorphism the original constituents of rocks are broken down into aggregates with the production mainly of hydrated minerals.

In his discussion of the gold-quartz veins the author calls attention to the fact that the wall rocks of the veins have been much altered by metasomatic processes. The changes effected in them consist mainly in the introduction of carbon dioxide, sulphur, and potassium and the abstraction of silica and sodium. The changes produced in a granodiorite by these processes have resulted in a new rock composed of: sericite = 61.11%, quartz = 25.00%, sphene = .60%, apatite = .46%, pyrite = 2.87%, $FeCO_3$ = .58%, $MgCO_3$ = 2.70%, and $CaCO_3$ = 7.23%. A siliceous argillite, originally consisting of a fine-grained aggregate of quartz, feldspar, brown mica, pyrrhotite, and organic matter, has been changed to an aggregate of sericite, calcite, and residuary quartz. The principal results of the interaction of the wall rock of the veins and the liquids emanating from the vein fissures are thus seen to be carbonates and sericite.

The Rocks of Castle Mountain, Mont. — The Castle Mountain mass in Central Montana is an eroded volcano, which presents "all the different types of crystallization and structure possible for an igneous magma to assume under the most varied conditions of cooling and pressure." In general, the rocks have been derived from a siliceous magma rich in alumina and the alkalies. This has given rise to the various members of the granite-rhyolite family in the district. Associated with these, but in much smaller amounts, are